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SUBSURFACE ENVIRONMENTAL SITE ASSESSMENT REPORT

GATX LINNTON TERMINAL
11400 N.W. ST. HELENS ROAD
PORTLAND, OREGON

PRIVILEGED & CONFIDENTIAL

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AGRA
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SUMMARY

AGRA Earth & Environmental, Inc. (AEE), has prepared this report to document the results of a Subsurface Environmental Site Assessment and product recovery test performed in October, 1995 at the GATX Linnton Terminal site, located at 11400 N.W. St. Helens Road, in Portland, Oregon. This work was performed to further evaluate subsurface conditions following the discovery of a leak in a small subsurface diesel fuel pipeline in December 1993. Subsurface soil and groundwater conditions were evaluated utilizing a series of five Geoprobe exploration performed in October, 1995.

The purpose of this work was to: 1) delineate the extent of subsurface petroleum hydrocarbon impact, particularly the extent of free phase product (product); 2) collect information for design of a product recovery system; 3) initiate interim manual product recovery; 4) arrange for the purchase and installation of an automated product recovery system, and 5) determine if additional product recovery measures would be necessary to prevent offsite migration of product. The results of our investigations have indicated the following:

- **Soils and Hydrogeology:** Subsurface soils encountered generally consisted of fine to medium sand to sandy gravel with varying amounts of silt (fill soils) to depths of approximately five to 7-1/2 feet below the surface, underlain by interlayered silty fine to medium sands and fine sandy and clayey silts. While it is likely that dredged fill soils may be present at the site, only the upper 7-1/2 feet of soil were able to be conclusively identified as fill. Soils interpreted to be native alluvium included an upper unit consisting predominately of silty fine to medium sand, and a lower unit consisting predominately of sandy to clayey silt. The contact between the upper silty sand unit and lower clayey silt unit was encountered at depths ranging from 18 to 23 feet below ground surface (bgs). The maximum depth explored was 36 feet bgs.

  The static water level in the site monitoring wells (corrected for the presence of product) on November 13, 1995 ranged from approximately 14 feet bgs in MW-2 to 19 feet bgs in MW-4. The groundwater flow direction appeared to be to the south/southeast. During the Geoprobe investigation, groundwater saturated soils were encountered at depths ranging from 14 feet bgs in GP-1 to 23 feet bgs in GP-5.

- **Liquid Phase Hydrocarbon Product Occurrence:** Product was noted in all four monitoring wells during visits to the site in October and November, 1995. Apparent product thicknesses of over ten feet were measured in monitoring wells MW-1, MW-2, and MW-3, and an apparent product thickness of 1.3 feet was measured in MW-4, an increase from the July, 1995 measurements. Product was also recovered during the collection of a water sample from Geoprobe boring GP-2. Apparent product thicknesses in the wells have subsequently decreased due to a combination of product bailing and rise in the river level.

A petroleum sheen and product have been noted on the adjacent Willamette River within the containment boom area, with the amount of sheen and product present appearing to be greatest at higher river stages. A single point of seepage into the river from the embankment could not be determined.

- **Soil Analytical Results:** Total petroleum hydrocarbon (TPH) concentrations greater than 800 parts per million (ppm) were detected in the upper soil samples analyzed from Geoprobe borings GP-2, GP-3, and GP-4. TPH concentrations in the upper soil samples from GP-1 and GP-5 and in the lower samples analyzed from all of the explorations were below 15 ppm. Low levels of polynuclear aromatic hydrocarbons (PAHs) were detected in three of the soil samples analyzed. A TPH-G concentration of 1,500 ppm and trace concentrations of aromatic volatile organic compounds (BTEX) were detected in the one sample which were analyzed for these constituents.

- **Groundwater Analytical Results:** The analytical results for groundwater samples indicated the presence of low levels of BTEX in the samples from all of the exploration locations, with a benzene concentration of 12 parts per billion (ppb) detected in the water sample from GP-3. Concentrations of TPH as gasoline were detected in all of the water samples analyzed, with concentrations ranging from 0.45 ppb to 18.4 ppb. In addition, PAHs were detected in the water samples collected from GP-1 and GP-3 with the concentrations of four PAH compounds above the Oregon Department of Environmental Quality (ODEQ) Basic Numeric Groundwater Cleanup Levels (BNGCLs). A groundwater sample collected from monitoring well MW-4 was analyzed for dissolved lead and no detectable concentrations of lead were present in the sample.

- **Product Recovery System Testing and Design:** The results of product bail-down recovery testing indicated estimated actual product thicknesses of 0.98 feet and 2.0 feet in the aquifer at MW-1 and MW-2, respectively. The tidal fluctuation in MW-1 over a one week period was measured at approximately one foot. The results of product viscosity and density testing were consistent with those for a diesel product. A product recovery system was specified and purchased which utilizes two pneumatic pumps and a product storage tank. The product recovery system was installed on November 13, 1995 and is currently operating.

- **Interim Manual Product Recovery:** Interim manual product recovery was initiated on October 18, 1995. As of November 13, 1995, a total of approximately 213 gallons of product were recovered from the four site monitoring wells through manual product recovery.

- **Conclusions:** Based on the results of the subsurface Geoprobe investigation, the approximate limits of product occurrence in the subsurface have been determined. The vertical extent of diesel impact has also been delineated. The extent of the dissolved phase gasoline plume has not been delineated. Based on field testing of product recharge and tidal groundwater fluctuations, and physical testing of product characteristics, an automated product recovery system was specified, purchased, and installed. The product recovery pumps started operation on November 20, 1995 and recovered approximately 100 gallons of product in the first two days of operation. This system will not be sufficient to prevent the offsite migration of product. Additional measures available to recover product and control product migration will be presented under separate cover.

The preceding summary is intended for introductory and reference use only, and should be used in conjunction with the full text of this report. The project description, site conditions, investigative techniques, and results are presented in the text of this report.

1.0 INTRODUCTION AND BACKGROUND

AGRA Earth & Environmental, Inc. (AEE), performed a Subsurface Environmental Site Assessment and product recovery test at the GATX Terminals Corporation (GATX) Linnton Terminal in October, 1995. The Linnton Terminal is located at 11400 N.W. St. Helens Road near the community of Linnton in Portland, Oregon (Figure 1, Site Location Map).

As presented in the request for proposal (RFP) dated September 22, 1995, a leak in a small subsurface diesel fuel pipeline was discovered in December 1993 near an approach to the wharf (Figure 2, Site Plan), and the pipeline was immediately removed from service. An estimate of the amount of free phase product (product) lost could not be made as it appeared the line may have at first leaked slowly for some time. Several months following the incident, product seepage into the river was noticed within 100 feet of the release point. This seepage was most noticeable at higher river stages and resulted in a product sheen with some separate phase floating product present at times.

A limited subsurface assessment was performed in July 1995 by another environmental consultant. This assessment included the installation of four monitoring wells, collection of soil and groundwater samples, and preparation of a summary report. At the time of the assessment, product was present in three of the four monitoring wells. Soil and water samples from the fourth well (MW-4), installed upgradient of the source of the leak, did not contain detectable concentrations of petroleum hydrocarbons.

1.1 PROJECT APPROACH

The information provided by GATX with the request for proposal indicated a release of diesel fuel from product piping leading to the wharf. The information provided in the request for proposal and obtained during our site visit on September 15, 1995 indicated that the product was beginning to seep into the Willamette River approximately several months following the discovery of the leak in December of 1993. The occurrence of seepage in the river apparently occurred during periods of elevated river and groundwater levels. The seepage of product was reported to occur from an area directly toward the river from the facility oil water separator (Figure 2). The quantity of the diesel release to the subsurface is unknown.

Four groundwater monitoring wells were installed by an environmental consultant under contract by GATX. The occurrence of product was recorded in the monitoring wells on two separate occasions prior to the preparation of AEE's work scope. The concentrations of hydrocarbon contaminants detected during groundwater sampling, the presence of product, the determined groundwater gradient, as well as a general seep location into the river indicated that the product plume extended from the release area, southeast toward the facility oil water separator (the vicinity of the reported product seep). This information indicated a generally localized product plume consisting of diesel fuel. The migration direction was anticipated to be consistent with the southeasterly groundwater gradient direction. Three parallel, wooden bulk-heads are located adjacent to the river and the lower bulkhead may provide a barrier to groundwater migration and influence the southern groundwater gradient that has been recorded. The existence of a more permeable groundwater flow corridor, consisting of a sand or gravel soil strata or fill material, could possibly explain the observed groundwater migration direction and location of the reported seep relative to the release area.

To characterize the extent of soil and groundwater impact present, AEE recently completed a subsurface Geoprobe investigation at the site, collected and analyzed information for design of a product recovery system, and initiated interim manual product recovery. The scope of work for this project consisted of: 1) performing a series of five Geoprobe explorations on the site; 2) collecting representative soil and groundwater samples from the Geoprobe explorations for subsurface information and quantitative analyses; 3) performing a product bail-down recovery test; 4) collection of water level fluctuation data; 5) designing/selecting equipment for a product recovery system; 6) initiating interim manual product recovery, and 7) preparation of a written report summarizing the results of the field investigations, quantitative results, conclusions, and recommendations for further work, if necessary.

This report has been prepared for the exclusive use of GATX Terminals Corporation and its agents, in accordance with generally-accepted professional consulting practices. No other warranty, expressed or implied, is made. The findings contained herein are relevant to the dates of AEE's site visits and should not be relied upon to represent conditions at later dates. In the event that changes in the nature, usage, or layout of the property or nearby properties are made, the conclusions and recommendations contained in this report may not be valid. If additional information becomes available, it should be provided to AEE so that the original conclusions and recommendations can be modified as necessary.

2.0 SITE AND AREA CONDITIONS

The GATX Linnton Terminal is located near the community of Linnton in Portland, Oregon on the southwestern bank of the Willamette River (Figure 1). The 13.69 acre petroleum storage, transfer, and terminal facility consists of an approximately 500,000 barrel liquid petroleum tank farm with 34 above ground petroleum storage tanks, associated piping and equipment, truck loading racks, a vapor recovery system, a fuel transfer pier, a boiler and pump house, two railroad spurs, an oil/water separator, a pipeline transfer station, and office and shop buildings. Most petroleum product is brought to the site via the Olympic Pipeline. Additional product arrives by barge and truck, and formerly by rail. Most product leaves the site by truck, with smaller quantities shipped via barge or pipeline. Petroleum products stored at the site include gasoline, diesel fuel, marine diesel, heavy fuel oil, and various grades of lubricating oils. The site was first developed in 1903 by Associated Oil, and was acquired by GATX from Phillips Petroleum in 1976.

2.1 GEOGRAPHY

The site is situated along the northwestern margin of the Portland Basin at the base of the Portland Hills. The subject property is bordered by the Willamette River to the northeast, N.W. St. Helens Road (U.S. Highway 30) to the southwest, and undeveloped or partially developed private property to the northwest and southeast.

The topography across the majority of the site is relatively flat, with an elevation of approximately 30 feet above mean sea level. On the east side of the site, the ground surface slopes down approximately 15 to 20 feet at an approximately 1:1 slope to the Willamette River. A series of three wooden bulkheads are present adjacent to the river. In the site location, the flow of the Willamette River is to the northwest, towards the Columbia River.

2.2 CLIMATE

The Portland area has a temperate climate, with wet winters and generally dry summers. The average annual rainfall in the Portland area is 37.4 inches, as measured at the Portland Airport Weather Service Office. More than 70% of this precipitation falls between the months of October and May. Mean monthly temperatures range from 39°F in January to 68°F in July.

2.3 REGIONAL GEOLOGY AND HYDROGEOLOGY

The site is located along the northwestern margin of the Portland Basin. Regional subsurface geology in the Portland Basin is characterized by Pleistocene to Holocene-aged alluvial floodplain and channel-fill deposits, consisting of unconsolidated, slightly stratified volcanic sand, silt, clay and gravels. Much of the coarse alluvium (gravels, cobbles and boulders) was derived from Pleistocene-aged catastrophic flooding events, and is mainly confined to low-lying terraces along the present channels of the Willamette and Columbia Rivers and their main tributaries. Beneath the unconsolidated alluvium is the Pliocene to Pleistocene-aged Troutdale Formation, which consists of consolidated conglomeritic, volcanoclastic gravels and sandstones, underlain by the Sandy River Mudstone. Beneath these sediments are the Miocene-aged flood basalts which form the Columbia River Basalt Group.

In U.S.G.S. Open File Report 0-90-2, soils in the site location were mapped as Quaternary alluvium, with the alluvial thickness indicated to be approximately 60 feet at the site location. Columbia River Basalt is exposed just southwest of the site along Highway 30.

Groundwater in the Portland Basin occurs under unconfined, confined and perched hydraulic conditions. Groundwater in regional unconsolidated sediments, specifically in floodplain areas, is generally unconfined and of potable quality. Specific capacities of the aquifers contained within the alluvium in the region are generally moderate, and groundwater availability is related to the base-flow of the Willamette and Columbia Rivers. The regional groundwater gradient is generally towards the northeast towards the adjacent Willamette River.

3.0 SUBSURFACE EXPLORATION AND CONDITIONS

3.1 SUBSURFACE EXPLORATION

AEE conducted field explorations on October 25 and 26, 1995, which consisted of advancing five Geoprobe borings to depths ranging from 30 to 36 feet below surface grade, and collecting soil and water samples. The locations of the Geoprobe borings are shown on Figure 2. Four borings were originally planned, with a fifth point added following the discovery of product in MW-4. The exploration strategy was to locate four of the borings beyond the presumed limits of the product plume, with one boring to be located within the product plume, southeast of MW-2. Geoprobe boring GP-1 was located approximately 62 feet northwest of existing monitoring well MW-3, near the river; GP-2 was located within the product plume approximately 54 feet southeast of MW-2; GP-3 was located approximately 140 feet southeast of MW-2, between the above ground storage tank area and the river; GP-4 was located approximately 72 feet southeast of MW-4, and GP-5 was located approximately 38 feet southwest of MW-4.

Geoprobe exploration work was performed by Geo-Tech Explorations, Inc., Tualatin, Oregon, utilizing a van-mounted Geoprobe 5400 sampling system. This system hydraulically pushes a probe rod to the desired depth of exploration. Soil samples were collected by advancing a stainless steel sampler at the desired sampling depth. Groundwater samples were collected by advancing the Geoprobe to the desired depth and pulling the probe rod back to expose a four-foot screened interval. Water samples were then collected through the probe rod using polyethylene tubing equipped with a one way check valve. The borings were properly abandoned using bentonite chips following the completion of sampling.

Soil samples were generally collected at five foot intervals, with continuous samples collected from GP-2. Two soil samples from each boring (one sample from extra boring GP-5) were submitted for analysis. One sample from each boring exhibiting the highest volatiles indications (typically the soil/water interface) and one sample from at or near the bottom of each boring were submitted for laboratory analysis. The water sample from GP-1 was collected from near the bottom of the boring in a silt horizon, with resultant slow water recharge. Therefore, in subsequent probe locations water samples were collected from sandier horizons when possible, in order to collect a sufficient sample volume.

Examination of the soil cores, combined with the logging of drilling characteristics, provided the basis of our geologic characterization of the exploration locations. Soil samples were observed and classified in the field by an AEE geologist. Representative portions of each soil sample were collected, placed in air-tight, Teflon-sealed containers, and were transported on ice to the analytical laboratories for quantitative analysis. Geologic boring logs are presented in Appendix A, and Geoprobe soil and groundwater sampling procedures are presented in Appendix B. Laboratory analytical reports and chain-of-custody records are presented in Appendix C. As the Geoprobe sampler is pushed through the subsurface, excess soil cuttings are not generated during drilling. One 55-gallon drum of decon water was generated during field work, and was stored on-site pending characterization for disposal.

3.2 SUBSURFACE CONDITIONS

Subsurface soils encountered consisted of fine to medium sand to sandy gravel with varying amounts of silt to depths of approximately five to 7-½ feet below the surface, underlain by interlayered silty fine to medium sands and fine sandy and clayey silts. While it is likely that dredged fill soils may be present at the site, only the upper 7-½ feet of soil were able to be conclusively identified as fill. Soils interpreted to be native alluvium included an upper unit consisting predominately of silty fine to medium sand, and a lower unit consisting predominately of sandy to clayey silt. The contact between the lower silt unit and the overlying silty sand unit was encountered at depths ranging from 18 to 23 feet bgs.

Groundwater was encountered at depths ranging from 14 feet below ground surface (bgs) in GP-1 to 23 feet bgs in GP-5.

3.2.1 Non-Native Fill

A surface cover of approximately four to six inches of 1-inch minus basaltic crushed rock was encountered in all of the exploration locations. Soils encountered beneath this surficial cover ranged from fine sandy silt with occasional gravel and rock to fine to medium sand and sandy gravel. These soils ranged in thickness from 4-½ to 7-½ feet.

3.2.2 Native Soils and Alluvial Deposits

Interlayered unconsolidated gray to brown silty fine to medium sands and fine sandy and clayey silts were encountered from five feet bgs to 36 feet bgs (the maximum depth explored). These soils included an upper unit consisting predominately of silty fine to medium sand, and a lower unit consisting predominately of sandy to clayey silt. A thin silt layer was present in the upper sand unit in GP-1, MW-3, and MW-1 (the three explorations along the river located furthest to the northwest). A silty fine sand layer was present in the lower silt unit in MW-2, GP-2, and GP-3 (the three explorations along the river located furthest to the southeast). The contact between the overlying silt unit and the lower silty sand unit was encountered at depths ranging from 18 feet bgs at GP-5 to 23 feet bgs at GP-1, with the contact appearing to dip down moderately towards the river.

Continuous sampling was performed at GP-2 (located within the product plume) to provide a more complete log of subsurface conditions. A soil core sample was unable to be collected from the interval from which the water sample was collected (18 to 22 feet). Soils present consisted of brown to gray silty fine sand from five to 22 feet (with a three inch layer of medium to coarse sand at 17 feet), gray clayey silt from 22 to 24 feet, gray silty fine sand from 24 to 30.5 feet, brown clayey silt from 30.5 to 34 feet, and brown silty fine to medium sand from 34 to 36 feet. Hydrocarbon indications (sheen, odor, and trace product) were noted from 17 to 30 feet, with product recovered during collection of a water sample from the 18 to 22 foot interval.

Examination of subsurface soil cores collected during the Geoprobe investigation indicated the presence of isolated brown product blebs in the 14 to 16 foot sample from GP-1, from 20 to 28 feet in GP-2, and in the 19 to 21 foot and 25 to 27 foot samples from GP-4.

3.2.3 Field Volatile Screening

AEE performed field volatile screening for all soil samples recovered from each Geoprobe boring. The volatiles measurements were recorded using a Minnie Rae photoionization detector (PID). This screening was performed to assist in the selection of soil samples to be submitted for analysis. The volatile measurements are recorded on the geologic boring logs (Appendix A). The highest volatiles readings were recorded for soil samples from Geoprobe borings GP-1, GP-2, and GP-3, located nearest the river. Volatiles readings of 1,816 parts per million (ppm), 184 ppm, and 450 ppm were detected for samples GP-1/S-4 (20-22 feet), GP-2/S-12 (22-24 feet), and GP-3/S-1 (4-6 feet), respectively.

Diesel-like odors were noted during the drilling of all of the Geoprobe borings. Detection of volatile odors is subjective information dependent on the olfactory sensitivity of the person classifying the sample, as well as other factors, including air and sample temperature, wind velocity, the length of time the sample is out of the boring, product type, and product degradation conditions. Headspace screening is also highly dependent on these other variables. No test standards exist, because these constraints are not readily quantifiable. Therefore, these observations should be considered as general subjective information.

3.2.4 Groundwater

Groundwater conditions at the site were evaluated by collecting fluid level measurements in the site monitoring wells and by observing the condition of soil samples collected during the Geoprobe investigation. In addition, a pressure transducer connected to a data logger was placed in monitoring well MW-1 to evaluate the influence of tidal fluctuations in the river on groundwater levels in the well over a one week period (Section 6.2).

Groundwater elevation data has been measured at the site in July, October, and November, 1995. The depth to water measurements were subtracted from the top of casing elevations to determine water level elevations in the wells, and the water levels were corrected for the presence of product using the measured product density. The relative casing elevations were previously established to a random location at the site. The relative groundwater surface elevation and apparent product thickness data for the well locations is presented in Table 3.2.4 below. Groundwater elevation data for July, 1995, (previously prepared by others) utilized an incorrect formula for the correction for product density. The elevation data was re-calculated using the correct formula and the measured product density.

One set of groundwater elevation data from each month was contoured to provide groundwater gradient information. Due to the limited number of monitoring well data points, the groundwater surface elevations were hand contoured. The contour plot for the July 26, 1995 indicates the direction of groundwater migration to be towards the south-southeast to south-southwest, at a gradient ranging from 0.01 to 0.017 ft/ft (Figure 3, Groundwater Gradient Map for July 26, 1995). The contour plot developed from the October 18, 1995 data indicates the direction of groundwater migration to be towards the south and southeast, at a gradient ranging from 0.01 to 0.04 ft/ft (Figure 4, Groundwater Gradient Map for October 18, 1995). The contour plot developed from the November 10, 1995 data indicates the direction of groundwater migration to be towards the southeast, at a gradient ranging from 0.006 to 0.027 ft/ft (Figure 5, Groundwater Gradient Map for November 10, 1995). The groundwater flow directions noted are somewhat anomalous in that while they are generally are towards the river, a significant component of flow is towards the southeast, opposite the flow of the river. This may reflect the location and number of measuring points or may be a factor of more permeable conditions in the vicinity of MW-2, and/or some tidal influence. Other lines of evidence support the presence of a preferential flow pathway in the vicinity of MW-2: 1) this is the area where the greatest thickness of product has been observed, 2) product bail-down recovery testing indicated more rapid recharge in this area, and 3) a sandy layer was noted in the underlying silt unit in the MW-2 boring log.

Hydrographs depicting product and groundwater levels for each well are presented as Figures 6, 7, 8, and 9. The most recent groundwater elevation ranged between 79.61 feet in MW-1 to 81.65 feet in MW-2. The groundwater elevations correspond to the observance of saturated soils during the Geoprobe exploration, which were encountered at 15 to 20 feet bgs in Geoprobe borings GP-1, GP-2, and GP-3 (nearest to the river), and 21 to 25 feet bgs in upgradient Geoprobe borings GP-4 and GP-5. The hydrographs also show that apparent product thicknesses are greatest during periods of low water and, as the water table rises, the apparent product thicknesses decrease, apparently flattening out. A pressure transducer connected to a data logger was placed in monitoring well MW-1 for a period of one week to evaluate the influence of tidal fluctuations in the river on groundwater levels in the well. As discussed in Section 6.2, a water level fluctuation of approximately one foot was noted in MW-1.

Water level information for the nearby Willamette River was obtained from the U.S. Army Corps of Engineers to assess the effects of river stage on product occurrence. Water level data for the river that corresponded to the dates of product and water level measurement in the site monitoring wells was plotted on Figure 10. As shown in Figure 10, as the river stage increases the apparent product thicknesses in the wells decreases.

TABLE 3.2.4

SUMMARY OF GROUNDWATER ELEVATION DATA
GATX Linnton Terminal
All Units in Feet

Well No.	Casing. Elevation *	Depth to Water	Depth to Product	Apparent Product Thickness	Corrected Groundwater Elevation **	Date
MW-1	94.80	16.83	16.6	0.23	78.17	7/18/95
		23.24	14.54	8.70	79.11	7/26/95
		26.70	16.3	10.40	77.13	10/18/95
		18.45	15.9	2.55	78.56	10/25/95
		23.02	16.19	6.83	77.71	10/31/95
		20.72	15.99	4.73	78.19	11/3/95
		21.27	16.52	4.75	77.65	11/7/95
		19.49	15.38	4.11	78.88	11/10/95
		16.14	15.04	1.10	79.61	11/13/95
MW-2	95.61	26.87	15.87	11.00	78.29	7/18/95
		24.75	15.54	9.21	78.85	7/26/95
		29.00	17.19	11.81	76.86	10/18/95
		24.75	16.69	8.06	77.86	10/26/95
		28.95	16.75	12.20	77.25	10/31/95
		28.40	16.63	11.77	77.43	11/3/95
		28.56	16.93	11.63	77.14	11/7/95
		23.59	16.22	7.37	78.42	11/10/95
		15.85	13.67	2.18	81.65	11/13/95
MW-3	96.06	15.25	14.84	0.41	81.17	7/18/95
		15.75	14.95	0.80	81.00	7/26/95
		25.95	14.55	11.40	80.01	10/18/95
		17.01	14.69	2.32	81.06	10/25/95
		16.60	15.08	1.52	80.78	10/31/95
		15.67	15.23	0.44	80.77	11/3/95
		15.91	15.33	0.58	80.65	11/7/95
		15.40	14.98	0.42	81.02	11/10/95
		14.72	14.44	0.28	81.58	11/13/95
MW-4	99.74	19.86	-	0.00	79.88	7/18/95
		19.88	-	0.00	79.86	7/26/95
		23.37	22.07	1.30	77.50	10/18/95
		22.32	21.4	0.92	78.22	10/25/95
		22.68	21.72	0.96	77.89	10/31/95
		21.70	21.19	0.51	78.48	11/3/95
		22.54	21.77	0.77	77.87	11/7/95
		21.10	20.53	0.57	79.13	11/10/95
		18.95	18.75	0.20	80.96	11/13/95

* Elevations based on report provided by GATX (report dated August 31, 1995, source unspecified)

**Corrected groundwater elevation calculated using the following formula:

Corrected groundwter elevation = Well casing elevation - depth to groundwater + 0.868 x (product thickness)

3.2.5 Free Phase Product Occurrence

Product was first noted several months after the release discovery in December 1993, appearing as a sheen and isolated product entering the Willamette River within approximately 100 feet of the release point. At the beginning of AEE's investigation in October, 1995, the presence of product was not observed on the river. In November 1995 a significant increase in the amount of product and sheen in the river was noted. The amount of product present on the river appears to be greatest at higher river stages.

Four groundwater monitoring wells were installed at the site by others in July 1995, with product identified in monitoring wells MW-1, MW-2, and MW-3 (the three closest to the river). During subsequent monitoring by AEE in October 1995, product was also noted in the upgradient well (MW-4).

Apparent product thicknesses for all of the dates monitored are presented in Table 3.2.4. The initiation of product bailing and a seasonal rise in water levels associated with a heavy rainfall event combined to decrease the apparent product thicknesses significantly. For information on product recovery refer to Section 7.0.

4.0 QUANTITATIVE ANALYSES

Selected soil samples were submitted for analysis for total petroleum hydrocarbons (TPH) by EPA Method 418.1 Modified, and for polynuclear aromatic hydrocarbons (PAHs) by EPA Method 8310. Based on the detection of gasoline range petroleum hydrocarbons in water samples, one soil sample (GP-3/S3(14-16')) was also analyzed for gasoline range fuel hydrocarbons by ODEQ Method TPH-G and for the aromatic volatile organic compounds (AVOCs) benzene, toluene, ethylbenzene, and xylenes (BTEX) by EPA Method 8020. The soil samples were selected for analysis based on their proximity to the soil/water interface and the base of the boring. If a sample was not recovered from the base of the boring, the sample closest to the base was submitted.

Groundwater samples collected were submitted for analysis for BTEX constituents by EPA Method 8020, for TPH by EPA Method 418.1, and for PAHs by EPA Method 8310. In addition, a groundwater sample from MW-4 (field filtered) was analyzed for dissolved lead by EPA Method 7421. Due to the presence of liquid phase product, the water sample collected from Geoprobe boring GP-2 was not analyzed.

One product sample collected from MW-2 was submitted for TPH analysis by EPA Method 8015-Modified, to quantify the types of petroleum hydrocarbon present.

Analytical testing was performed by AEE's in-house analytical laboratory in Portland, Oregon, and North Creek Analytical, Beaverton, Oregon. The results of the analysis of the soil and groundwater samples collected from the Geoprobe borings are shown on Figures 11 and 12, respectively. The laboratory analytical reports and chain-of-custody documentation are presented in Appendix C.

4.1 ODEQ CLEANUP LEVELS

Sites which have been impacted by releases from above-ground storage tanks are not specifically covered by existing state or federal regulations. To provide a frame of reference for the concentrations of the detected contaminants, the Oregon Department of Environmental Quality (ODEQ) SOCLEAN industrial maximum allowable standards for soils are referenced in the analytical summary tables for soils. For groundwater, the Basic Numeric Groundwater Cleanup Levels (BNGCLs), which apply to sites where groundwater is impacted by fuel hydrocarbon releases, have been referenced.

4.2 SOIL ANALYSES

4.2.1 Total Petroleum Hydrocarbons (EPA Method 418.1 Modified)

A total of nine soil samples were submitted for analysis for TPH by EPA Method 418.1 Modified. These consisted of two samples each from Geoprobe borings GP-1, GP-2, GP-3, and GP-4, and one soil sample from GP-5. The results of the TPH analyses are summarized in Table 4.2.1.

Table 4.2.1
Summary of Soil TPH Analytical Data

Date	Sample I.D.	Sample Location	Sample Depth(ft)	TPH (ppm)
10/25/95	GP-1/S-4 (19-21')	Geoprobe GP-1	19 to 21	12.8
"	GP-1/S-6 (28-30')	Geoprobe GP-1	28 to 30	6.18
"	GP-2/S-12 (22-24')	Geoprobe GP-2	22 to 24	801
"	GP-2/S-17 (32-34')	Geoprobe GP-2	32 to 34	4.44
"	GP-3/S-3 (14-16')	Geoprobe GP-3	14 to 16	11,600
"	GP-3/S-7 (34-36')	Geoprobe GP-3	34 to 36	14.9
10/26/95	GP-4/S-4 (19-21')	Geoprobe GP-4	19 to 21	6,000
"	GP-4/S-6 (28-30')	Geoprobe GP-4	28-30	13.8
"	GP-5/S-4 (19-21')	Geoprobe GP-5	19-21	4.09

Notes: ND - Not detected in the sample
ppm - Parts per million

As indicated by these results, TPH concentrations were detected in all of the soil samples submitted for analysis, with the highest TPH concentrations detected in samples GP-2/S-12(22-24'), GP-3/S-3(14-16'), and GP-4/S-4(19-21'). The TPH concentrations detected in the deepest Geoprobe samples submitted were all below 15 ppm.

4.2.2 Polynuclear Aromatic Hydrocarbons (EPA Method 8310)

A total of nine soil samples were submitted for analysis for PAHs by EPA Method 8310. These consisted of two samples each from Geoprobe borings GP-1, GP-2, GP-3, and GP-4, and one soil sample from GP-5. The results of the PAH analyses are summarized in Table 4.2.2.

Table 4.2.2
Summary of Soil PAH Analytical Data

Date	Sample I.D.	Sample Location	Sample Depth(ft)	PAHs Detected (ppm)	ODEQ SOCLEAN (industrial) (ppm)
10/25/95	GP-1/S-4 (19-21')	Geoprobe GP-1	19 to 21	Benzo(a)anthracene: 0.068 Benzo(a)pyrene: 0.86 Chrysene: 1.3 Fluoranthene: 0.11 Pyrene: 0.20	Benzo(a)anthracene: 1.0 Benzo(a)pyrene: 1.0 Chrysene: 1.0 Fluoranthene: 80,000 Pyrene: 60,000
"	GP-1/S-6 (28-30')	Geoprobe GP-1	28 to 30	ND	NA
"	GP-2/S-12 (22-24')	Geoprobe GP-2	22 to 24	Phenanthrene:1.9	Phenanthrene: NR
"	GP-2/S-17 (32-34')	Geoprobe GP-3	32 to 34	ND	NA
"	GP-3/S-3 (14-16)	Geoprobe GP-3	14 to 16	ND	NA
"	GP-3/S-7 (34-36')	Geoprobe GP-3	34 to 36	ND	NA
10/26/95	GP-4/S-4 (19-21')	Geoprobe GP-4	19 to 21	Fluorene: 1.0	Fluorene: 80,000
"	GP-4/S-6 (28-30')	Geoprobe GP-4	28 to 30	ND	NA
"	GP-5/S-4 ((19-21')	Geoprobe GP-5	19 to 21	ND	NA

Notes:
ND - Not detected in the sample
NR - Not regulated
NA - Not applicable
ppm - Parts per million

As indicated by these results, relatively low PAH concentrations were detected in three of the nine soil samples submitted.

4.2.3 Gasoline Range Fuel Hydrocarbons (ODEQ Method TPH-G)

One soil sample (GP-3/S-3(14-16')) was analyzed for gasoline range fuel hydrocarbons by ODEQ Method TPH-G. A TPH-G concentration of 1,500 ppm was detected in this sample.

4.2.4 Aromatic Volatile Organic Compounds (EPA Method 8020)

One soil sample (GP-3/S-3(14-16')) was analyzed for BTEX by EPA Method 8020. The results for this sample are summarized in Table 4.2.4.

Table 4.2.4
Summary of Soil BTEX Analytical Data (ppm)

Date	Sample I.D.	Sample Location	Sample Depth (ft)	Benzene	Toluene	Ethyl benzene	Xylenes
10/25/95	GP-3/S-3 (14-16)	Geoprobe GP-3	14 to 16	ND	0.72	2.6	11
ODEQ SOCLEAN Industrial Levels*				2	6,000	20,000	2,500

Notes: ND - Not detected in the sample
ppm - Parts per million
* - For reference purposes only

All of the detected BTEX constituents were present at concentrations below the ODEQ SOCLEAN Industrial Cleanup levels.

4.3 GROUNDWATER ANALYSES

4.3.1 Aromatic Volatile Organic Compounds (EPA Method 8020)

A total of four groundwater samples were analyzed for BTEX compounds by EPA Method 8020. In addition, a QA/QC trip blank sample was also analyzed. Due to the presence of benzene in the samples at concentrations above what would be expected for diesel, the chromatograms were evaluated for the presence of TPH as gasoline. Examination of the chromatograms indicated the presence of gasoline range hydrocarbons in all of the water samples analyzed with the presence of the gasoline additive methyl tert butyl ether (MTBE) noted in the chromatograms for the samples from GP-1 and GP-2. The evaluation of the chromatograms is included as Appendix D and the TPH-G concentrations are included with the BTEX results in Table 4.3.1.

Table 4.3.1
Summary of Groundwater BTEX Analytical Data

Date	Sample I.D.	Sample Location	Sample Depth (ft)	B (ppb)	T (ppb)	E (ppb)	X (ppb)	TPH-G* (ppb)
10/25/95	GP-1/W-1	Geoprobe GP-1	30 to 34	2.4	0.54	ND	0.69	31
"	GP-3/W-1	Geoprobe GP-3	18 to 22	12	7.2	1.3	5.1	2,300
"	GP-4/W-1	Geoprobe GP-4	21 to 25	1.6	1.1	0.64	ND	120
"	GP-5/W-1	Geoprobe GP-5	24 to 28	0.69	ND	ND	ND	200
"	Trip Blank	Trip Blank	NA	ND	ND	ND	ND	NA
BNGCL**				5	1,000	700	10,000	NR

Notes: B - benzene
T - toluene
E - ethylbenzene
X - xylenes
ppb - Parts per billion
* - TPH-G concentrations calculated from 8020 chromatograph.

ND - Not detected in the sample
NA - Not applicable
NR - Not regulated
** - BNGCLs adopted from EPA MCLs for UST sites, for reference purposes only.

As indicated by these results, BTEX constituents were detected in all of the groundwater samples collected, with the benzene concentration detected in the sample from GP-3 slightly above the ODEQ BNGCL of 5 ppb for this compound. BTEX constituents were not detected in the QA/QC trip blank sample.

4.3.2 Total Petroleum Hydrocarbons (EPA Method 418.1)

A total of four groundwater samples were analyzed for TPH by EPA Method 418.1, as an initial screening test for the potential presence of PAHs. The results of these analyses are summarized in Table 4.3.2.

Table 4.3.2
Summary of Groundwater TPH Analytical Data

Date	Sample I.D.	Sample Location	Sample Depth(ft)	TPH (ppm)
10/26/95 *	GP-1/W-1	Geoprobe GP-1	30 to 34	0.45
10/25/95	GP-3/W-1	Geoprobe GP-3	18 to 22	18.4
10/26/95	GP-4/W-1	Geoprobe GP-4	21 to 25	3.99
10/26/95	GP-5/W-1	Geoprobe GP-5	24 to 28	1.62

Notes: ND - Not detected in the sample
ppm - Parts per million
* - Probe rods left in overnight in order to collect sample.

TPH concentrations were detected in all four of the samples submitted, with the highest concentration (18.4 ppm) detected in the sample collected from GP-3 at a depth of 18 to 22 feet.

4.3.3 Polynuclear Aromatic Hydrocarbons (EPA Method 8310)

A total of four groundwater samples were submitted for analysis for PAHs by EPA Method 8310. The results of these analyses are summarized in Table 4.3.3.

Table 4.3.3
Summary of Groundwater PAH Analytical Data

Date	Sample I.D.	Sample Location	Sample Depth(ft)	PAHs Detected (ppb)	ODEQ BNGCLs (ppb)
10/26/95 *	GP-1/W-1	Geoprobe GP-1	30 to 34	Benzo(a)anthracene: 0.27 Benzo(a)pyrene: 0.17 Benzo(k)fluoranthene: 0.11	Benzo(a)anthracene: 0.1 Benzo(a)pyrene: 0.2 Benzo(k)fluoranthene: 0.2
10/25/95	GP-3/W-1	Geoprobe GP-3	18 to 22	Benzo(a)anthracene: 6.4 Benzo(a)pyrene: ND Benzo(b)fluoranthene: 1.8 Benzo(g,h,i)perylene: 8.4 Benzo(k)fluoranthene: 2.6 Chrysene: 5.7 Acenaphthene: 11 Anthracene: 3.7 Fluroanthene: 16 Fluorene: 25 Phenanthrene: 47 Pyrene: 16	Benzo(a)anthracene: 0.1 Benzo(a)pyrene: 0.2 Benzo(b)fluoranthene: 0.2 Benzo(g,h,i)perylene: NR Benzo(k)fluoranthene: 0.2 Chrysene: 0.2 Acenaphthene: 420 Anthracene: 2,100 Fluroanthene: 280 Fluorene: 280 Phenanthrene: NR Pyrene: 210
10/26/95	GP-4/W-1	Geoprobe GP-4	21 to 25	ND	NA
10/26/95	GP-5/W-1	Geoprobe GP-5	24 to 28	ND	NA

Notes:
ND - Not detected in the sample
NA - Not applicable
ppb - Parts per billion
* - Probe rods left in overnight in order to collect sample.

PAH concentrations were detected in two of the four samples submitted. The greatest number of PAH compounds and highest concentrations were detected in the sample from GP-3, located just north of the large above-ground storage tank farm. The concentrations of four of the PAH compounds detected in this sample, and one PAH detected in the sample from GP-1 were above the BNGCLs for these compounds.

4.3.4 Dissolved Lead (EPA Method 7421)

A groundwater sample collected from MW-4 on November 10, 1995 following the removal of product was field filtered and submitted for analysis for dissolved lead by EPA Method 7421. No detectable concentrations of lead were present in the sample.

4.4 PRODUCT ANALYSES

One product sample was collected from MW-2 on November 6, 1995 was analyzed for total petroleum hydrocarbons by EPA Method 8015-Modified. Analytical results indicated petroleum hydrocarbon concentrations of 132,000 ppm in the gasoline range, 674,000 ppm in the diesel range, and <74,000 ppm in the heavy oil range. As noted on the laboratory report, the chromatographic peak pattern indicated that diesel range hydrocarbons were eluting within the gasoline range.

Two other product samples were collected for physical characteristics testing, including viscosity and density. The results of physical characteristics testing is presented in Section 6.3.

5.0 NATURE AND EXTENT OF CONTAMINATION

During the course of the subsurface investigation and product recovery tests, the extent of the product and dissolved phase hydrocarbon plumes were explored. Liquid phase petroleum hydrocarbons appear to parallel the shoreline from between GP-1 and MW-3 to between GP-2 and GP-3, an approximate distance of 300 feet, and extend southwest of the shore to MW-4 and GP-4 for a maximum distance of 120 feet. The saturated thickness of the product over this entire area is not known. The bulk of the contaminant consists of diesel range petroleum hydrocarbons, although detectable concentrations of gasoline were present in groundwater samples collected from all of the exploratory Geoprobe points.

During the rise of the Willamette River and the corresponding rise in the water table, product has seeped into the river. A single point of seepage could not be identified due to the areal extent of product paralleling the shoreline, and movement of the product within the containment boom by wind and currents. There may be a preferential pathway in the subsurface for the product to migrate; however, due to the observance of product in all exploratory borings and monitoring wells paralleling the river, it is possible that product is seeping into the river at more than one location.

5.1 LIQUID PHASE HYDROCARBONS

Based on the results of the product recovery test (Section 6.1), the saturated thickness of product in the soils surrounding MW-1 and MW-2 was estimated to be 0.98 feet and 2.0 feet, respectively. Discontinuous liquid phase petroleum hydrocarbons resembling diesel were observed in subsurface soils in geoprobe borings GP-1, GP-2, and GP-4. With the rise in the river stage, and subsequent rise in groundwater elevation, product has migrated to the Willamette River. The product plume appears to extent from GP-1 to GP-2, parallel to the shoreline, and from the bulkhead slope to MW-4 and GP-4.

5.2 DISSOLVED PHASE HYDROCARBONS

The extent of the dissolved phase diesel hydrocarbon plume has been constrained but not defined. Dissolved phase petroleum hydrocarbon diesel constituents were detected in all Geoprobe groundwater samples, with concentrations decreasing laterally from the source of the release. Based on decreasing TPH and PAH concentrations with depth, the approximate vertical extent of the diesel impact is 36 feet bgs. The TPH concentrations detected in the deepest Geoprobe samples were all below 15 ppm and no detectable PAH concentrations were present in samples collected from a depth below 28 feet.

The source of gasoline constituents is not known, and the extent of the gasoline plume has not been delineated. The relative quantity of gasoline to diesel is minor and the detected concentrations of BTEX constituents were relatively low, in comparison to the ODEQ cleanup standards. BTEX constituents and TPH as gasoline were detected in all groundwater samples collected from the Geoprobe exploration points, with the highest concentrations observed in the groundwater sample collected from GP-3. Only one soil sample, collected from GP-3, was analyzed for gasoline, which was detected in the sample.

6.0 PRODUCT REMOVAL ACTIVITIES

6.1 PRODUCT BAIL-DOWN RECOVERY TESTING

The product recovery tests were conducted at monitoring wells MW-1, MW-2 and MW-3 and followed the testing format outlined in the article by Gruszczenski (1987). A copy of this article was provided in AEE's Proposal dated September 20, 1995. The product recovery test is used to estimate the estimated actual product thickness in the aquifer near each well tested and to estimate the rate of product recovery.

From the graphs of the elevation of product and water recovery in the wells after the bail-down of the product, the actual product thickness in the surrounding aquifer is estimated. Data from the monitoring well MW-1 product recovery test indicates an estimated actual product thickness in the aquifer of 0.98 feet and an estimated capillary fringe above the water table of 2.07 feet. The data from monitoring well MW-2 indicates an estimated actual product thickness in the aquifer of 2.0 feet and an estimated capillary fringe of 1.87 feet. Test results from MW-3 are inconclusive since the recovering groundwater elevation did not provide a clear transition, further, the small "bumps" in the recovery curve may be indicative of the multiple soil strata present at MW-3. These soil strata are shown on the boring log for MW-3 provided with the request for proposal. A copy of the graphs is provided as Appendix E and the following table summarizes the test results.

Table 6.1.1
Estimated Product Thickness

Well Number	Static Product Thickness in Well*	Estimated Product Thickness in Aquifer **	Estimated Capillary Fringe in Aquifer **
MW-1	10.40 feet	0.98 feet	2.07 feet
MW-2	11.81 feet	2.00 feet	1.87 feet
MW-3	11.40 feet	inconclusive	inconclusive

* as recorded prior to testing on October 18, 1995
** as determined by testing conducted on October 18, 1995

Using the rate of recovery of product into the wells (MW-1, MW-2, and MW-3), the estimated rate of product recovery for continuously operating system is 40 gallons per day for two well system and 50 gallons per day for a three well system, based on the fluid levels present at the time the test was conducted. The estimated rate of product recovery is used to determine the minimum recovery rate of the pumping system and provide an indication of how often the storage tank must be pumped out. The rate of product recovery may be higher during the start of the recovery system and decrease over time.

6.2 TIDAL FLUID LEVEL FLUCTUATION ANALYSIS

Groundwater depth monitoring provides an estimate of the tidal influence on the site monitoring wells. A daily fluctuation in a water level of more than two feet would preclude the use of the pneumatic pump for product recovery. Following completion of product recovery testing on October 18, 1995, a submersible pressure transducer was placed into monitoring well MW-1 and connected to a Unidata 7000 series data-logger. MW-1 was selected because of its location near the Willamette River. The submersible pressure transducer is used to record the depth of water above the transducer and the water temperature. The information was collected on 15 minute intervals for a one week period (October 18 to October 25, 1995). The collected data indicates a daily groundwater elevation change of approximately one foot in monitoring well MW-1. A copy of the data was previously provided in correspondence dated October 27, 1995.

Since the change in groundwater depth did not exceed two feet during this one week period, it is feasible to use a pneumatically operated pump at the site.

6.3 PHYSICAL TESTING OF PRODUCT CHARACTERISTICS

6.3.1 *Product Viscosity Analysis*

Two product samples were collected on October 18, 1995 from monitoring wells MW-1 and MW-2. The samples of product were submitted to Columbia Inspection, Inc. for viscosity analysis by ASTM D-445. The viscosity of the product is used to determine the effectiveness of hydrophobic screens when recovering product. The following table summarizes the results and a copy of the data is attached.

MONITORING WELL	VISCOSITY
MW-1	2.63 Centistokes
MW-2	2.54 Centistokes

Viscosity of the product provides an indication if the hydrophobic screen will be effective or prone to clogging. No firm viscosity value is used to select or reject the use of hydrophobic screens, however, viscosity values in excess of 200 centistokes tends to limit the rate of recovery achieved by recovery pumps with hydrophobic screens. Due to the fluctuation of the product level thickness, the hydrophobic screens will be used to prevent the recovery of significant quantities of groundwater.

6.3.2 Product Specific Gravity Analysis

Two samples of product were collected from monitoring wells MW-1 and MW-2 and were submitted for analysis for density by ASTM D-1298. The density test were conducted at 59 degrees F, the same as the measured groundwater temperature. Specific gravity results are as follows:

WELL NUMBER	DENSITY
MW-1	0.8692 grams per mL
MW-2	0.8666 grams per mL

The specific gravities measured are consistent with that of a diesel product. The specific gravity test results are used to aid in determining piezometric groundwater elevation by compensation for the density of product. This information is also used in the estimating the actual product thickness in the aquifer as discussed above.

7.0 PRODUCT REMOVAL ACTIVITIES

7.1 MANUAL PRODUCT REMOVAL

An interim product removal program was initiated on October 18, 1995. Product from 4-inch diameter monitoring wells MW-1, MW-2, and MW-3 and 2-inch monitoring well MW-4 was initially hand bailed on a weekly basis, increasing to a twice weekly basis in November 1995. By mid-November, apparent product thicknesses in the wells had decreased significantly, likely due to a combination of product removal activities and rising groundwater levels associated with a rise in the level of the nearby Willamette River. As of November 13, 1995, a total of approximately 213 gallons of product had been recovered from the wells. This product was temporarily stored in 55-gallon drums pending arrival of a 550-gallon capacity double-walled dike tank. Product removal totals for each well are summarized in Table 7.1 below.

Table 7.1
Product Removal Totals (in gallons)

DATE	MW-1	MW-2	MW-3	MW-4	DAILY TOTAL	CUMULATIVE TOTAL
10/18/95	23	22	17	2	64	64
10/25/95	10	15	7	2	34	98
10/31/95	10	27	2	0.75	39.75	137.75
11/3/95	6	17	2	0.5	25.5	163.25
11/7/95	6	16	0.5	0.5	23	186.25
11/10/95	5	10	0.5	0.5	16	202.25
11/13/95	4.5	4	2	0.25	10.75	213
Subtotal	64.5	111	31	6.5	213	213

7.2 PUMP INSTALLATION

On October 18, 1995, AEE personnel conducted product recovery testing, installed a data logger for recording groundwater depth over a one week interval, and collected product samples for laboratory analysis. The results of this testing have been detailed above, in Section 6.0. From these test results, AEE recommended the purchase and installation of pneumatically operated product recovery pumps. Recommended equipment purchase consisted of: Two inch Hammer Head pumps with hydrophobic screens manufactured by QED; Ace double wall, UL listed, product storage tank; and a QED high product tank shut-off switch. The pneumatically operated product pumps are designed to be installed and operated within monitoring wells.

The product pumps were installed in MW-1 and MW-2 on November 17, 1995. The hydrophobic screens were allowed to become saturated with product for 48 hours prior to operation, and on November 20, 1995 automated pumping system began continuous operation. The pumps operated from a compressed air source present at the facility. Nylon tubing is used to connect the compressed air source to the product pumps and to connect the product pumps to the product storage tank. Compressed air lines and product recovery lines are located above ground surface. The piping and flow diagram is provided in Appendix F.

Measurements taken of the liquid levels in the product storage tank on November 22, 1995 (two days after the start of continuous operation), indicated that approximately 100 gallons of product and seven gallons of water had been recovered. The amount of product recovered during this two days of operations is close to the estimated rate as indicated in the AEE letter dated October 27, 1995, Selection and Recommendation for Purchase of Free Product Recovery Pumps. For a two well recovery system, a recovery rate of 40 gallons of product per day was estimated.

On November 22, 1995, the product level in monitoring wells MW-1 and MW-2 was also measured. MW-1 did not contain measurable quantities of product and MW-2 contained approximately eight inches of product. The pump in MW-2 was operational and the recovery of product continues.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the subsurface Geoprobe investigation, the approximate lateral limits of product occurrence and dissolved phase diesel plume have been estimated. The vertical extent of diesel impact has been delineated. The product plume appears to extend from geoprobe points GP-1 to GP-2, parallel to the shoreline, and from the bulkhead slope to MW-4 and GP-4. A single source of the product entry to the Willamette River could not be identified and it is likely that saturated thicknesses of product exist beneath the bulkhead slope.

The presence of a low level dissolved phase gasoline plume was discovered during the subsurface investigation. The source of this release is not known and the extent of this plume has not been delineated.

Product recovery pumps have been installed in monitoring wells MW-1 and MW-2 and have recovered 100 gallons of product in the initial two day period of operation. While this system will recover product in the vicinity of monitoring wells MW-1 and MW-2, it will not prevent further offsite migration of product or capture product that may be present in the bulkhead slope. In order to control the further migration of product present in the subsurface parallel to the shoreline, additional product recovery wells will be necessary. To prevent the offsite migration of product in the area of the bulkhead slope, product recovery in combination with groundwater gradient control will be necessary. The details of these options will be presented under separate cover.

We are pleased to be of service to you on this project. If you have any questions or desire further clarification, do not hesitate to contact the undersigned at (503) 639-3400.

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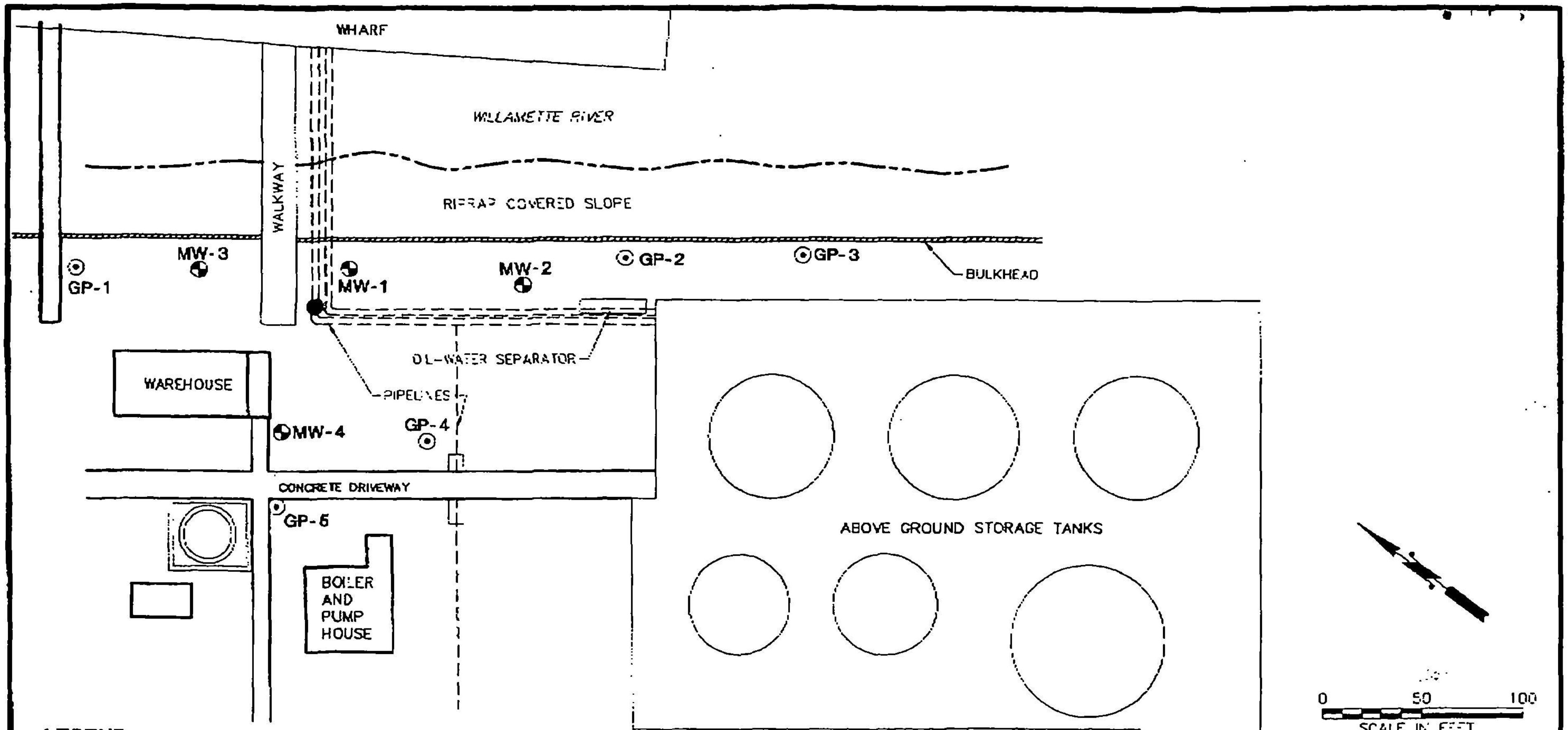


LEGEND

MW-4 — EXISTING MONITORING WELL NUMBER AND APPROXIMATE LOCATION

GP-5 — GEOPROBE BORING NUMBER AND APPROXIMATE LOCATION

● APPROXIMATE LOCATION OF DIESEL RELEASE

NOTES:

1. BASE MAP PREPARED FROM A DRAWING SUPPLIED BY GATX, ENTITLED "FIGURE 2 - GATX TANK STORAGE FACILITY - SITE PLAN", DATED AUGUST 1995
2. ALL LOCATIONS ARE APPROXIMATE.
3. MAP SHOWS SOUTHEAST PORTION OF GATX TANK STORAGE FACILITY.
4. LIMITED SURFACE AND SUBSURFACE FEATURES SHOWN.

FIGURE 2

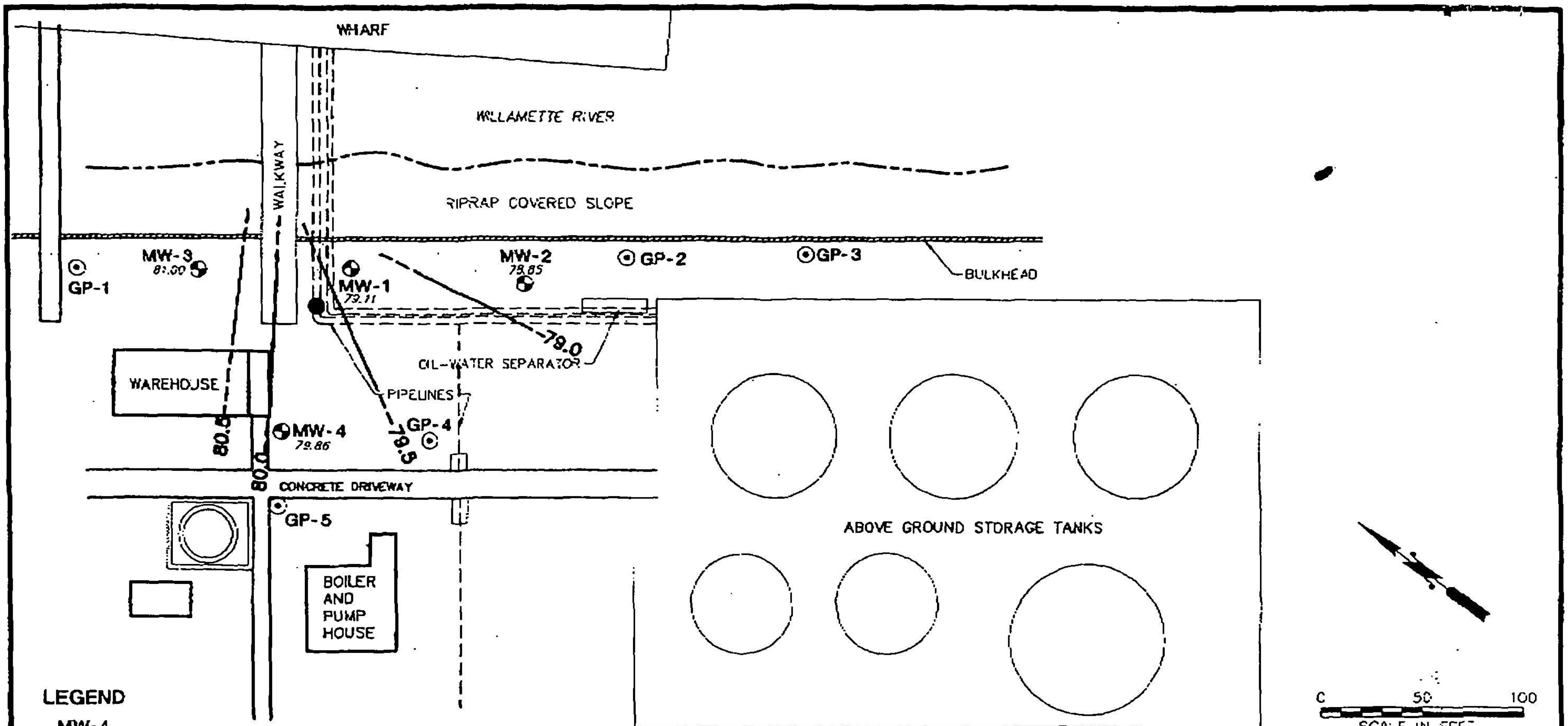
AGRA Earth & Environmental
7477 S.W. Tech Center Drive
Portland, OR, U.S.A. 97223-8025

W.O.	21-08388-00
DESGN	SME
DRAWN	GW
DATE	SEPT 1995
SCALE	1"=50'

GATX TERMINALS CORPORATION
11400 NW ST. HELENS ROAD
PORTLAND, OREGON

SITE PLAN

AGRA EARTH & ENVIRONMENTAL, INC. DRAWING NO. \PROJECTS\21\08388\SITEPLR.DWG



LEGEND

MW-4	EXISTING MONITORING WELL NUMBER AND APPROXIMATE LOCATION
GP-5	GEOPROBE BORING NUMBER AND APPROXIMATE LOCATION
●	APPROXIMATE LOCATION OF DIESEL RELEASE
—80.0—	INFERRED GROUNDWATER SURFACE ELEVATION CONTOUR IN FEET
79.86	SPOT GROUNDWATER SURFACE ELEVATION IN FEET

NOTES:

1. BASE MAP PREPARED FROM A DRAWING SUPPLIED BY GATX, ENTITLED "FIGURE 2 – GATX TANK STORAGE FACILITY – SITE PLAN", DATED AUGUST 1995.
2. ALL LOCATIONS ARE APPROXIMATE.
3. MAP SHOWS SOUTHEAST PORTION OF GATX TANK STORAGE FACILITY.
4. LIMITED SURFACE AND SUBSURFACE FEATURES SHOWN.

FIGURE 3

AGRA Earth & Environmental
7477 S.W. Tech Center Drive
Portland, OR, U.S.A. 97223-8025

W.O.	21-08388-00
DESIGN	SME
DRAWN	GW
DATE	NOV 1995
SCALE	1"=50'

GATX TERMINALS CORPORATION
11400 NW ST. HELENS ROAD
PORTLAND, OREGON

GROUNDWATER GRADIENT MAP
FOR JULY 28, 1995

AGRA EARTH & ENVIRONMENTAL INC. DRAWING NO. \PROJECTS\21\08388\GW-0795.DWG